REFERENCES

Das, I. (1990): Additional records for Chelonians from Northern India. *J. Bombay Nat. Hist. Soc. 87(1)*: 91-97.

Moll, E.O. (1987): Survey of the freshwater turtles of India. Part II. The genus *Kachuga*. *J. Bombay Nat. Hist. Soc. 84(1)*: 7-25.

Sarma, P.K. (2007): Habitat ecology, population status and distribution of *Kachuga sylhetensis* (Jerdon) in certain districts of Assam. (Ph.D. Thesis) Gauhati University. 137 pp.

8. A NOTE ON THE OCCURRENCE OF NON-STYGOBITIC FISHES IN A CAVE IN ANDHRA PRADESH, PENINSULAR INDIA

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What with its vast territory, ancient and varied geomorphology, hydrology, and climate, the Indian subterranean domain has given rise to numerous natural caves and cavities of varied shapes and sizes. A small tract such as the Tungabhadra River Valley in Andhra Pradesh alone has more than one hundred caves (Prasad 1996). Generally characterized by perpetual darkness, low energy input and remarkable constancy of temperature and humidity, caves are inhabited by highly diversified organisms, ranging from protozoans to mammals besides bacteria and fungi. The typical cave/groundwater dwellers have originated from their extinct/extant epigean ancestors of marine, freshwater or terrestrial habitats at different times and in different ways. Hence, the subterranean realm (stygon) has come to be regarded as a promising place to look for insights into biological adaptation and speciation (Rouch 1986). That the Indian caves harbour rich biodiversity can be gauged by the fact that a recent preliminary study of just a single collection from the sandy bottom of a cave (Kotumsar Cave) has led to the discovery of three new taxonomically and biogeographically significant stygobitic crustacean taxa, together with a new amphipod family (Ranga Reddy 2006; Messouli *et al.* 2007; Ranga Reddy and Defaye 2009). Nevertheless, groundwater biology as a whole has received scant attention in India (Ranga Reddy 2002, 2004).

Based on their degree of adaptation to groundwater life, the hypogean aquatic fauna are generally classified into three broad ecological groups: stygobites or stygobionts, stygophiles, and stygoxenes. Stygobites are obligatorily confined to caves or other subterranean passages and exhibit a suite of stygomorphic characters such as the loss of eyes and melanin pigment (regressive features), and elaboration of other sensory structures like the lateral organs in fishes and antennae in insects and crustaceans (progressive features) (Proudlove 2006). While stygophiles can live, feed and reproduce in both epigean and hypogean habitats and show some degree of stygomorphic/behavioural adaptations, stygoxenes cannot complete their life in hypogean habitats and are not much different from their epigean counterparts.

As for the Indian subterranean fish fauna, only five stygobitic fish species are known till date, comprising two clariid catfishes (*Horaglanis krishnai* Menon 1950 and *H. alikunhii* Babu & Nayar 2004) and three synbranchid eels (*Monopterus eapeni* Talwar 1991, *M. roseni* Bailey & Gans 1998, and *M. digressus* Gopi 2002), all from the State of Kerala. Hora (1924) recorded eight non-stygobitic fishes for the first time from an Indian cave (Siju Cave, Assam), which included five cyprinids, namely *Neolissochilus hexastichus* (McClelland 1839) (= *Barbus hexastichus*), *Barilius barna* (Hamilton 1822), *Barilius bendelisis* (Hamilton 1807), *Devario aequipinnatus* (McClelland 1839) (= *Danio aequipinnatus*) and *Psilorhynchus sucatio* (Hamilton 1822), an unidentified species of the balitorid genus *Nemacheilus*, an ambassid, *Chanda nama* (Hamilton 1822), and the walking snakehead, *Channa orientalis* Bloch & Schneider 1807 (*Ophiocephalus gachua* in source). Since then, only four non-stygobitic species are known from the Indian caves: three loaches, namely *Schistura sijuensis* (Menon 1987) from Siju cave, *Indoreonectes evezardi* (Day 1872) from Kotumsar cave, Chhatisgarh and *Schisturia papulifera* Kottelat, Harries & Proudlove 2007 from a cave of Synrang Pamiang system, Meghalaya, and a lone specimen of an unidentified schizothoracine fish from a cave near Udaipur, Rajasthan (Tehsin *et al.* 1988). On the other hand, the world tally of the described subterranean fish species, as of 2003, is 125 (Proudlove 2006).

This note is meant to report on a fortuitous collection of seven non-stygobitic fish species from Nelabilum cave (15° 00' 05" N; 78° 03' 20" E), which is located south-east of Ankireddipalle village in Kurnool district of Andhra Pradesh in peninsular India. According to Gebauer (2003), the cave is

a 'partly explored and partly mapped' natural cave and perennial spring in Precambrian (Algonkian) Narji limestone (Low. Kurnool). The natural subvertical fissure of the cave has been modified by man into a sort of a stepwell, giving access to groundwater. A 60 m long passage, including two flights of steps, leads to 'what looks like a penetrable sump' with clear water (depth 10 m). The existence of the cave is threatened by increasing industrial activity in the area by way of limestone quarrying for slabs and cement. As in the case of most Indian caves, practically nothing is known about the biology of the cave.

All the specimens reported herein were collected at the cave entrance on three dates by one of the authors (YRR) and/or his field assistants, using plankton net and/or baited hooks, and preserved in formalin. Counts and measurements follow Kottelat (2001) while nomenclature and ecology are based on Froese and Pauly (2009). Morphometric data are presented as percentages of standard length, with averages in parentheses. On October 3, 2005, water temperature of the cave was 27°C, air temperature 27°C and pH 6.5.

Specimens are deposited in the Department of Zoology, Acharya Nagarjuna University, Nagarjunanagar 522 510, pending transfer to the National Collections of Zoological Survey of India, Kolkata.

Puntius sarana (Hamilton 1822)

Material examined: 23 specimens, 49-160 mm SL; 3.x.2005.

D iii 8, P i 14, V i 7-8, A iii 5, L.l. 28-32. Head length 26.25-30.0 (28.38), body depth 26.66-33.12 (31.27), predorsal distance 42.85-53.33 (47.08), preventral distance 46.66-55.0 (51.92), preanal distance 60.00-71.86 (68.99), base of dorsal fin 15.62-18.33 (18.68), base of anal fin 22.00-26.66 (21.96), length of pectoral fin 18.33-20.62 (20.49), least height of caudal peduncle 13.33-15.60 (14.13), eye diameter 8.3-10.2 (9.2), snout length 9.37-11.2 (10.10), interorbital distance 10.2-11.8 (11.2).

Body oblong, compressed and deep; head with 2 pairs of barbels, rostral and maxillary, maxillary barbels longer, extending beyond hind margin of orbit; third unbranched ray of dorsal fin osseous, strong with minute serrations along posterior margin, basal region of dorsal and anal fins each covered with row of scales, auxiliary scale occurring at axle of ventral; dorsum uniformly olive, flanks silvery; in juveniles, 5-6 pigment bands present above lateral line and a dark vertical band covered by opercular membrane; an oval diffused dark spot on 26th to 28th lateral line scales. Body coloration, barbels, and eye diameter are as in the epigean forms.

This is a widely distributed Asiatic species. It is reportedly benthopelagic and potamodromous, occurring in freshwaters, but tolerant to brackish conditions.

Puntius ticto (Hamilton, 1822)

Material examined: 1 specimen, 29 mm SL. 3.x.2005.

D iii 8, P i 13, V i 6, A ii 5, L.l. 23. Head length 28.57, body depth 39.28, predorsal distance 53.57, preventral distance 57.14, preanal distance 67.85, base of dorsal 17.85, base of anal 14.28, length of pectoral 21.42, least height of caudal peduncle 17.85, eye diameter 8.5, snout length 10.6 and interorbital distance 10.7.

Body compressed, deep, barbels absent, lower jaw protruding beyond upper jaw, mouth upturned, third unbranched ray of dorsal with fine serrations along posterior border, a blotch on 3rd to 5th scales and a large distinct circular spot on the 17th to 19th lateral scales above anal. The present specimen agrees with its epigean counterparts in body coloration.

This species is known to inhabit still, shallow, marginal waters of rivers and tanks, subtropical in distribution and benthopelagic in habits, feeding on the organisms present on muddy bottom.

Rasbora daniconius (Hamilton, 1822)

Material examined: 5 specimens; 62-68 mm. SL. 3.x.2005.

D ii 7, P i 13-14, V i 9, A ii 5, L. l. 30-31. Head length 26.47 - 27.42 (26.94), body depth 16.12-7.64 (16.88), predorsal distance 51.47- 54.83 (53.15), preventral distance 45.16-48.52 (46.34), preanal distance 64.51-78.72 (68.28), base of dorsal 11.29-17.02 (13.73), base of anal 11.29-12.76 (11.52), length of pectoral 20.96-23.40 (21.23), least height of caudal peduncle 9.67-11.76 (10.71), eye diameter 6.4-7.3 (7.1), snout length 5.8-6.4 (6.1), interorbital distance 7.1-8.82 (7.66).

Body compressed, lower jaw projecting beyond upper jaw, symphysial knob on lower jaw, mouth small, upturned, caudal fin forked. Lateral line parallel to the ventral body contour, a grayish band occurring mid-laterally and extending from behind orbit to caudal fin. The narrow stripe generally seen above the base of anal fin in the epigean forms is not discernible in the present specimens.

This species is predominantly freshwater, inhabiting slow-flowing sandy streams and rivers. It is benthopelagic and potamodromous.

Garra gotyla stenorhynchus Jerdon, 1849

Material examined: 1 specimen; 47 mm SL. 3.x.2005.

D iii 5, P i 14, V i 14, A iii 5, L. l. 32. Head length 25.53, body depth 23.40, predorsal distance 48.93, preventral distance 57.44, preanal distance 78.72, base of dorsal 17.02, base of anal 12.76, length of pectoral 23.40, least height of caudal peduncle 12.76; eye diameter 8.5, snout length 10.6, interorbital distance 14.8.

Body subcylindrical, snout with a well-formed median proboscis and a transverse lobe at its tip, mouth arched, a mental adhesive disc associated with the lower jaw, 2 pairs of barbels, anterior ones longer, origin of dorsal fin nearer the snout, a black spot is present at the upper angle of the gill opening. In the preset specimen, an elliptical spot close to caudal fin is noticed, which has not hitherto been reported for this species.

A hillstream inhabitant, this species is endemic to peninsular India. It is benthopelagic.

Mystus cavasius (Hamilton 1822)

Material examined: 3 specimens, 88-102 mm SL. 30.x.2005.

D I 7, P I 8, V i 5, A iv 7-9. Head length 22.5, body depth 20.0, predorsal distance 35.0, preventral distance 48.75, preanal distance 66.25, base of adipose dorsal 40.0, base of anal 10.0, length of pectoral 15.0, least height of caudal peduncle 8.75, eye diameter 6.25-7.6 (7.5), snout length 8.6-8.9 (8.7), interorbital distance 7.2-7.9 (7.6).

Body elongate, occipital process narrow reaching the basal bone of rayed dorsal, median fontanelle long, extending to the base of occipital process, 4 pairs of barbels, maxillary barbels long, reaching base of caudal fin; rayed dorsal fin high and pointed, its spine weak, first dorsal ray long, base of adipose dorsal fin long, its origin closely behind rayed dorsal; pectoral spine strong with denticulations on inner margin, origin of ventral vertically below last ray of dorsal fin; a dark spot at the basal bone of rayed dorsal, a humeral spot and a band on upper flanks, belly white. The present specimens are not different from the epigean forms in body coloration and eye diameter.

This species is tropical, demersal, amphidromous, living in fresh- and brackish waters.

Mystus bleekeri (Day, 1877)

Material examined: one specimen, 95 mm SL. 30.x.2005.

D I 7, P I 9, V i 5, A iii 7. Head length 23.52, body depth 24.50, predorsal distance 32.35, preventral distance 45.09, preanal distance 64.70, base of adipose dorsal 36.27, base of anal 11.76, length of pectoral 16.66, least height of caudal peduncle 6.86, eye diameter 7.8, snout length 8.8, interorbital distance 8.2.

Body elongate, occipital process reaching basal bone of rayed dorsal, 4 pairs of barbels, maxillary pair extending up to anal fin, adipose dorsal long, originating closely behind rayed dorsal, ventral originating vertically below adipose dorsal, upper part of body grayish, grayish band occurring on either side of lateral line, lower band reaching ventral fin, a dark blotch behind opercle, rayed dorsal and caudal fins dark in colour. The present specimens accord well with the epigean forms in body coloration.

This is a demersal, potamodromous, widely distributed Asian species, inhabiting lakes, tanks, canals and rivers.

Channa orientalis Bloch & Schneider 1801

Material examined: 2 specimens, 110-125 mm SL. 9.iii.2008.

D 35, P 15, V 6, A 22, L.l. 45. Head length 28.12-32.32 (30.22), body depth 20.33-22.22 (21.27), predorsal distance 32.22-36.36 (34.28), prepectoral distance 28.81-32.32 (30.56), preanal distance 46.52-52.61 (49.51), base of dorsal fin 40.10-49.10 (45.60), base of anal 36.36-37.28 (36.82), length of pectoral fin 22.03-22.22 (22.12), length of ventral 10.31-12.52 (11.41), eye diameter 4.9-5.21 (5.11), snout length 7.89-8.23 (8.11), interorbital distance 8.11-8.20 (8.15).

Body elongate, eyes moderate, lower jaw longer than upper, with 12 caniniform teeth, 5 scales between orbit and preopercular angle, 12 predorsal scales, 45 lateral line scales, lateral line bending at 12th scale, pectoral fin reaching anal fin, ventral smaller than pectoral, caudal fin round in shape; body dark green dorsally, a row of dark oblique bands on the flanks above and below lateral line, a dark band extending anteriorly from opercle to snout and passing onto orbit, ventral body pale in colour, pectoral fin with vertical black bands, caudal fin with vertical stripes, dorsal and anal with narrow white outer margin, ocellus occurring on lower part of last 5 dorsal fin rays. Body coloration is same as in epigean forms.

This species is benthopelagic, potamodromous, inhabiting fresh- and brackish waters and widely distributed in Asia.

CONCLUSION

None of the species reported herein is as yet known from any cave habitat. All are benthopelagic and potamodromous except for *Mystus* spp., which are demersal. Particularly, the occurrence in the Nelabilum cave of

Garra gotyla stenorhynchus is puzzling, given its general preference for swift-flowing mountain streams. On the whole, all these species appear to be accidental stygoxenes in the cave.

It is noteworthy that all the five blind and/or depigmented fishes from India are known to occur only in Kerala State, where the lateritic soil formation with its network of crevicular hypogean habitats seems to favour the evolution of stygobitic fishes. Lateritic soils cover an area of 100,000 sq. km along the west coast of India in the States of Kerala, Karnataka, Maharashtra and Goa (Venkata Reddy 1997), besides the hilly areas of Orissa and Assam. Further faunistic surveys in these States are likely to bring to light several more significant finds of stygobitic fishes.

While precious little is know about the biodiversity of the Indian caves, caves themselves are now endangered, inter aila, by increasing industrial and agricultural activities (Biswas 2009). Hence, the governmental and non-governmental organisations need to play proactive role in preserving the fragile cave ecosystems and encourage research in this vital area of basic science.

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REFERENCES

Babu, K.K.S. & C.K.G. Nayar (2004): A new species of the blind fish *Horaglanis* Menon (Siluroidea: Clariidae) from Parappukara (Trichur District) and a new report of *Horaglanis krishnai* Menon from Ettumanur (Kottayam District), Kerala. *J. Bombay Nat. Hist. Soc. 101*: 296-298.

Bailey, R.M. & C. Gans (1998): Two new synbranchid fishes, *Monopterus roseni* from peninsular India and *M. desilvai* from Sri Lanka. *Occasional Papers of the Museum of Zoology of the University of Michigan* No. 726: 1-18.

Biswas, J. (2009): The biodiversity Krem Mawkhyrdop of Meghalaya, India, on the verge of extinction. *Curr. Sci. 96*: 904-910.

Day, F. (1872): Monograph of Indian Cyprinidae, Part 2. *J. Asiat. Soc. Beng. 41*: 1-29, 171-198, and 318-327.

Froese, R. & D. Pauly (Eds.) (2009): FishBase World Wide Web electronic publication www.fishbase.org, version (02/2009).

Gebauer, L. (2003): South Asia cave registry. Gebauer, Schwäbisch Gmünd, Germany.

Gopi, K.C. (2002): A new synbranchid fish, *Monopterus digressus* from Kerala, peninsular India. *Rec. zool. Surv. India 100*: 137-143.

Hamilton-Buchanan, F. (1822): An account of the fishes found in the river Ganges and its branches. Edinburgh and London. vii + 405 pp. + 39 pls.

Hora, S.L. (1924): Fishes of the Siju Cave, Garo Hills, Assam. *Rec. Indian Mus. 26*: 27-31.

Kottelat, M. (2001): Fishes of Laos. Wildlife Heritage Trust, Cambodia. 198 pp.

Kottelat, M., D.R. Harries & G.S. Proudlove (2007): *Sclistura papulifera*, a new species of cave loach from Meghalaya, India (Teleostei: Balitoridae). *Zootaxa 1393*: 35-44.

Messouli, M., J.R. Holsinger & Y. Ranga Reddy (2007): Kotumsaridae, a new family of subterranean amphipod crustaceans from India, with description of *Kotumsaria bastarensis*, new genus, new species. *Zootaxa 1589*: 33-46.

Menon, A.G.K. (1950): On a remarkable blind siluroid fish of the family Clariidae from Kerala, India. *Rec. Ind. Mus. 48*: 59-66.

Menon, A.G.K. (1987): *Noemacheilus sijuesis* sp. nov. The fauna of India and adjacent countries. Pisces, Zoological Survey of India. IV. Teleostei-Cobitidae, Part 1, Homolopteidea: 175.

Prasad, K.N. (1996): Pleistocene cave fauna from peninsular India. *J. Caves & Karst Stud. 58*: 30-34.

Proudlove, G.S. (2006): Subterranean fishes of the world. An account of the subterranean (hypogean) fishes described up to 2003 with a bibliography 1541-2004. International Society for Subterranean Biology, Moulis, xviii + 304 pp.

Ranga Reddy, Y. (2002): Why neglect groundwater biology? *Curr. Sci. 83*: 931-932.

Ranga Reddy, Y. (2004): Little known biodiversity of subterranean freshwater habitats in India, with special reference to crustacean fauna. *J. Bombay Nat. Hist. Soc. 101*: 186-189.

Ranga Reddy, Y. (2006): First Asian report of the genus *Chilibathynella* Noodt, 1963 (Bathynellacea, Syncarida), with the description and biogeographic significance of a new species from Kotumsar Cave, India. *Zootaxa 1370*: 23-37.

Ranga Reddy, Y. & D. Defaye (2009): Two new Parastenocarididae (Copepoda, Harpacticoida) from India: *Parastenocaris muvattupuzha* n. sp. from a river and *P. kotumsarensis* n. sp. from a cave. *Zootaxa 2077*: 31-55.

Rouch, R. (1986): Sur l'écologie des eaux souterraines dans le karst. *Stygologia 2*: 352-399.

Talwar, P.K. & A.G. Jhingran (1991): Inland fishes of India and adjacent countries. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1185 pp.

Tehsin, R., V.S. Durve & M. Kulshreshtha (1988): Occurrence of a schizothoracine fish (snow trout) in a subterranean cave near Udaipur, Rajasthan. *J. Bombay Nat. Hist. Soc. 85*: 211- 212.

Venkata Reddy, D. (1997): Engineering Geology for Civil Engineers. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi. 390 pp.